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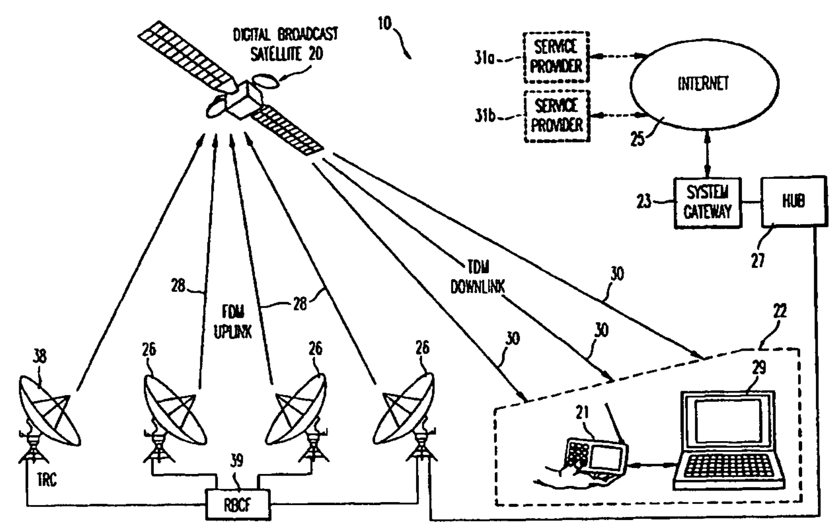

(57) Abstract

A satellite direct digital broadcast system is provided which broadcasts selected Internet information such as news reports, weather reports and stock market rates, along with radio programs. Broadcast channels comprise Internet information and a service control header to identify the type of Internet information contained therein. User terminals (22) are provided which comprise a radio broadcast receiver (2) to receive programs broadcast via satellite (20). Audio programs are played on a speaker connected to a radio broadcast receiver (21). The user terminals (22) also comprise a multimedia device such as a personal computer (29) connected to the receiver. The multimedia device is programmed to generate a computer display which prompts a user to select a topic of Internet information. The multimedia device stores received packets and selectively retrieves packets to generate displays such as Web pages using those packets which correspond to the topic of information selected by the user.

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SYSTEM FOR SELECTIVELY DOWNLOADING INFORMATION AT USER TERMINALS FROM THE INTERNET USING A SATELLITE BROADCAST SYSTEM

Field of the Invention

The present invention relates generally to a system for providing remote user terminals with broadcast Internet information without requiring a backhaul link from the terminals to Internet service providers.

Background of the Invention

Due to the expanding, worldwide use of personal computing devices, telecommunications devices and the Internet, the global economy is currently undergoing an information revolution that is expected to be as significant as the industrial revolution of the nineteenth century. A significantly large population of people, however, are generally undeserved and dissatisfied with their telecommunications options and are therefore presently limited in their ability to participate in this information revolution. This population of people is primarily located in Africa, Central America, South America and Asia, where communication services have, to date, been characterized by the poor sound quality of short-wave radio broadcasts, or the coverage limitations of amplitude modulation (AM) band and frequency modulation (FM) band terrestrial radio broadcast systems.

A satellite-based direct radio broadcast system to transmit audio and data signals, including images, to low-cost consumer receivers in essentially any part of the world has been proposed. The satellite-based direct radio broadcast system provides a number of advantages over existing satellite systems, such as the ability to provide portable services. Many existing satellite systems fail to provide portable services because they require large satellite antennas to access such systems. While a number of other existing satellite systems can provide

portable or mobile communication services, these systems do not provide adequate channel capacity to provide the high outbound data rates required for transmission of information from the Internet and the World Wide Web (WWW) to many different users.

A satellite-based direct radio broadcast system, however, is limited in that the receivers are one-way and do not permit users to transmit voice or other information. Users of these receivers, therefore, cannot communicate bi-directionally via the satellite-based direct radio broadcast system and, accordingly, do not have access to the Internet. In many conventional Internet access systems, a user connects with an Internet access provider using a computer and a communication link such as a public switched telephone network. A series of screens are generated on the monitor of the user's computer which prompt the user to select the kind of information the user seeks to obtain from the Internet. For example, the user may elect to use Netscape Navigator™ software available from Netscape Communications Corporation™ of Mountain View, California to access documents on the World Wide Web portion of the Internet. The Netscape Navigator™ software allows the user to enter key words relating to selected topics which are transmitted to a Web search engine, for example, to obtain information on the selected topics. Existing radio broadcast receivers are not configured with a communication link between the users and the Internet access providers with which to interactively select and download information from the Internet.

A substantial amount of information on the Internet, however, is relevant to such a large population as to make the provision of the same information to different users, at different times, on different communication channels, and in response to individual user requests, an inefficient use of bandwidth and other satellite communication system resources. Thus, a need exists for a low-cost user terminal which provides users with the advantages of a satellite-based direct radio broadcast system (e.g., large geographic coverage, good sound quality, high outbound data rates and low cost), as well as the ability to receive selected broadcast information from the Internet.

Summary of the Invention

In view of the foregoing disadvantages and limitations, it is an object of the present invention to provide a satellite direct digital broadcast system which can broadcast selected

Internet information to low-cost user terminals. The selected Internet information can be, for example, weather reports, news reports, stock market rates, consumer catalogs, among other types of information.

A further object of the present invention is to broadcast selected types of Internet information as packets in broadcast channels. Internet packets are streamed over broadcast channels of the satellite direct digital broadcast system. A broadcast channel can carry one or more types of Internet information such as news, weather, stock reports, and so on. Also, the Internet packets contain the information necessary to select specific pages (e.g., categories of Internet information) by means of a browser.

A further object of the present invention is to provide low-cost user terminal comprising a radio broadcast receiver which is adapted for connection to a multimedia device such as a personal computer.

It is still a further object of the invention to provide the user terminal with a user interface for selecting the type of broadcast Internet information to be stored for display purposes at the user terminal. The user terminal uses the selection entered via a user interface to examine stored packets and retrieve those packets corresponding to the Internet information-type selection by the user. The packets are displayed (or played, if audio) using a multimedia device.

These and other objects of the present invention are achieved, in part, by providing remote users with user terminals which incorporate both a broadcast receiver for receiving satellite direct radio broadcasts, and a multimedia device for storing and displaying selected information from an Internet service provider which has been broadcast via a satellite direct radio broadcast system. The user terminals are programmed to convert user information selections indicating the type of Internet information desired by the user into control signals for commanding the multimedia device to extract those received packets corresponding to the user information selections for display or playback purposes.

In one aspect, therefore, an Internet service provider has a gateway configured to route selected multimedia data from the Internet/WWW to a broadcast station. The broadcast station formats the Internet packet data into a broadcast program comprising the packets and transmits the broadcast program to a satellite in the satellite direct digital broadcast system. The service provider supplies additional information to identify those

packets which correspond to the different types of Internet information (e.g., news, consumer catalogs, educational program, and so on) in the broadcast programs.

In another aspect, the present invention is directed to a method for providing a low-cost, global, portable user terminal with at least limited access to information services available via the Internet. The method comprises the steps of generating screen prompts on a multimedia device (e.g., a personal computer) connected to a radio broadcast receiver. The screen prompts allow a user to select from among different types of Internet information which are broadcast via a satellite direct digital broadcast system. The receiver demultiplexes and decodes data received from the satellite direct radio broadcast system to obtain the broadcast channels. User responses to screen prompts are processed by the computer to configure the computer to extract selected packets in the broadcast channels which constitute a broadcast program comprising Internet information. The multimedia device first stores packets from the broadcast channel in a large memory device such as a disk drive for later access by the user.

Brief Description of the Drawings

The various objects, advantages and novel features of the present invention will be more readily comprehended from the following detailed description when read in conjunction with the appended drawings, in which:

Fig. 1 is a diagrammatic illustration of the manner in which Internet information can be broadcast to users through a satellite direct radio broadcast system in accordance with a preferred embodiment of the present invention;

Fig. 2 is a schematic block diagram illustrating the operation of a broadcast station depicted in Fig. 1 in accordance with an embodiment of the present invention;

Fig. 3 is a diagrammatic illustration of the manner in which broadcast channels are formatted by a broadcast station into prime rate channels for transmission to the satellite depicted in Fig. 1 in accordance with an embodiment of the present invention;

Fig. 4 illustrates the manner in which on-board satellite signal processing may be carried out in a satellite direct radio broadcast system of the type shown in Fig. 1;

Fig. 5 is a schematic block diagram of on-board processing components of the satellite depicted in Fig. 1;

Fig. 6 is a block diagram illustrating the construction of a user terminal which incorporates both a digital broadcast receiver and a multimedia device such as a personal computer in accordance with a preferred embodiment of the present invention;

Fig. 7 is a flow chart which summarizes the series of operations carried out by the user terminal of Fig. 5 when downloading selected packets of received broadcast Internet information in accordance with an embodiment of the present invention; and

Fig. 8 is an exemplary computer screen generated by the user terminal in accordance with an embodiment of the present invention.

Throughout the drawing figures, like reference numerals will be understood to refer to like parts and components.

Detailed Description of the Preferred Embodiments

The satellite communications system 10 of the present invention is described below in accordance with the following general outline:

I. Overview of System Operation

II. Broadcast Station

III. Satellite

IV. User Terminals

I. Overview of System Operation

With reference to Fig. 1, a system 10 is provided which allows a remotely located user to receive high quality sound, data and images using a low-cost receiver, and to select one or more broadcast channels comprising Internet information to download to a computer connected to the receiver in accordance with the present invention. The system 10 is preferably implemented using a satellite direct digital broadcast system. The direct digital broadcast system preferably consists of three geostationary satellites (one of which is indicated at 20 in Fig. 1), low cost radio receivers or user terminals, and associated ground networks. For illustrative purposes, a single user terminal 22 is shown which comprises a hand-held radio receiver 21 connected to a multimedia device such as a computer 29.

Broadcast programs are transmitted to the satellite 20 via one or more broadcast stations 26. As will be described in further detail below, the broadcast stations 26 perform coding, multiplexing and other signal processing on programs comprising audio, data or both to create broadcast channels (BCS) that are transmitted to the satellite 20 in uplinks 28. The uplinks 28 are preferably frequency division multiplexed carriers which carry BCS in terms of prime rate channels (PRCs). Each PRC provides a prime rate increment (PRI) of 16 kbps at baseband. A BC preferably comprises 1 to 8 PRCs. For each PRC, the BC is assigned 224 bits every 432 milliseconds in a service control header (SCH). The BCS carry packets, some of which constitute programs originating from the Internet. In accordance with the present invention, the type of Internet information is identified in the SCH. The satellite 20 performs baseband processing on the uplinks 28 to transmit the PRCs of the BC to the user terminals 22 on at least one of three time division multiplexed downlinks 30.

With continued reference to Fig. 1, the broadcast stations 26 can be provided with multimedia information (e.g., sound bytes, video and Web pages) from the Internet 25 directly via a system gateway 23 and a hub 27. The system gateway 23 can operate as an Internet service provider, as well as perform operations which are common to two or more Internet service providers indicated generally at 31 and combined at the hub 27.

In accordance with an aspect of the present invention, news reports, weather reports, stock market rates, educational programs, consumer catalogs and other information that is accessible via the Internet are provided to the broadcast stations 26 in the system 10. The system 10 determines which type of Internet information is to be broadcast and at which times. The system 10 comprises a regional broadcast control facility (RBCF) 39 which can be used to assign channels on the uplinks 28 to different broadcast stations 26. For example, channels in the uplinks 28 can be assigned to one or more broadcast stations 26 to broadcast news continuously for 24 hours a day. One of the broadcast stations 26 can be controlled to provide stock market data during the operating times for that particular market. At all other times, the broadcast station can be configured to broadcast stock market news commentary and regional news at alternate one-half hour intervals. Further, a broadcast station can be configured to broadcast weather reports continuously on one broadcast channel, as well as to simultaneously broadcast educational programs and consumer catalogs at specified times during the day on another broadcast channel. A schedule of broadcast programs and their

corresponding broadcast times and channels is distributed among the users. The users can therefore decide when and to what TDM downlink 30 to tune the receiver to receive a particular program, including programs comprising Internet information.

In addition, browser pages for different consumer broadcast packages can be assembled at a central location (e.g., a service provider 31a) and provided at one or more broadcast stations 26. The browser pages for a consumer broadcast package can provide the current news highlights and stock quotes for the present day, while another consumer broadcast page provides a browser page dedicated to sports highlights. The program material can be obtained from the Internet, providing the basis for placing Internet addresses in packets for their selective downloading and display on a multimedia device connected to a receiver.

In accordance with the present invention, each user terminal 22 is configured to receive satellite direct radio broadcast programs via a radio receiver 21. As stated previously, the receiver 21 can be tuned to receive broadcast programs from a selected one of the three downlinks 30. The receiver 21 is configured to demultiplex and decode the selected downlink 30 to obtain broadcast channels that were transmitted from the broadcast stations 26 and provided to the downlink 30 by the satellite 20. The computer 29 connected to the receiver 22 processes the demultiplexed and decoded and stored data to extract packets corresponding to a selected category or type of Internet information requested by a user. The computer 29 stores and then annunciates the information, that is, displays the information on a computer monitor or plays audio portions of the selected Internet information on a loudspeaker connected to the computer.

Using the multimedia device, the user can request to view, listen to or store a particular type of information which has been demultiplexed, decoded and stored from broadcast channels 100 (Fig. 3). An input device (e.g., a mouse or a keyboard) can be used to respond to screen prompts generated by the computer 29. The screen prompts are preferably one or more screens having menus for listing different information types (e.g., news, weather, educational programs, consumer products, stock market reports, and so on) and corresponding icons. The user can click on an icon using a mouse, for example. The computer 29 processes the mouse input to determine which menu item has been selected and

to configure the computer 29 to annunciate stored Internet information corresponding to the user's selection, as described in further detail below in connection with Figs. 7 and 8.

The system 10 is advantageous because it can download relatively large amounts of information from one or more Internet service providers, for example, to a user terminal 22 efficiently and cost effectively using the satellite direct radio broadcast system. Different types of information such as news and weather reports are desired by such a great number of people that broadcasting the information to all user terminals 22 for selective reception is more cost effective than providing the data to the space segment each time it is requested by a user. In addition to conserving the space segment, broadcasting popular Internet information and providing user terminals with means to select from among the broadcast Internet information does not require modification of the broadcast system to include a backhaul link with which to communicate user requests and responses to an Internet service provider in order to obtain Internet information.

II. Broadcast Station

The direct radio broadcast system uses digital audio coding techniques. Each satellite 20 delivers direct radio audio signals having qualities equivalent to AM monaural, FM monaural, FM stereo and CD stereo throughout its respective coverage area, together with ancillary data such as paging, video and text transmissions directly to the user terminals 22. The system can also deliver multimedia services such as large database downloads to personal computers (PCs) for business applications, map and printed text information for travelers, and color images to augment audio programs for advertising and entertainment.

Signal processing to convert digital data streams from one or more broadcast station 26 into parallel streams for transmission to a satellite 20 will now be described with reference to Fig. 2. For illustrative purposes, four sources 60, 64, 68 and 72 of program information are shown. Two sources 60 and 64, or 68 and 72, are coded and transmitted together as part of a single broadcast program or service. The coding of the program comprising combined sources 60 and 64 will be described. The signal processing of the program comprising information from sources 68 and 72 is identical.

Broadcast stations 26 assemble information from one or more sources 60 and 64 for a particular program into broadcast channels which are preferably characterized by increments of 16 kbps. These increments are referred to as prime rate increments or PRIs. Thus, the bit rate carried in a broadcast channel 100, as shown in Fig. 3, is n x 16 kbps were n is the number of PRIs used by that particular broadcast service provider. In addition, each 16 kbps PRI can be further divided into two 8 kbps segments 101 and 103 (Fig. 3) which are routed or switched together through the system 10. The segments 101 and 103 provide a mechanism for carrying two different service items in the same PRI such as a data stream with low bit rate speech signals, or two low bit rate speech channels for two respective languages, and so on. The number of PRIs are preferably predetermined, that is, set in accordance with program code. The number n, however, is not a physical limitation of the system 10. The value of n is generally set on the basis of business concerns such as the cost of a single broadcast channel and the willingness of the service providers to pay.

For illustrative purposes, n for the first broadcast channel 59 for sources 60 and 64 is equal to 4. The value of n for the broadcast channel 67 for sources 68 and 72 is set to 6 in the illustrated embodiment. As stated previously, the value of n can be changed. For example, a greater number of PRIs can be required if one of the sources 60, 64, 68 or 72 is a source for Internet information to be broadcast, particularly if the information comprises a video component.

With continued reference to Fig. 2, more than one broadcast service provider can have access to a single broadcast station 26. For example, a first service provider generates broadcast channel 59, while a second service provider can generate broadcast channel 67. The signal processing described herein and in accordance with the present invention allows digital data streams from several broadcast service providers to be broadcast to a satellite in parallel streams which reduces the cost of broadcasting for the service providers and maximizes use of the space segment. By maximizing efficiency of space segment usage, the broadcast stations 26 can be implemented less expensively using less power-consuming components. For example, the antenna at the broadcast station 26 can be very small aperture terminal (VSAT) antenna. The payload on the satellite requires less memory, less processing capability and therefore fewer power sources which reduces payload weight.

A broadcast channel 59 or 67 is characterized by a frame 100 having a period duration of 432 ms, as shown in Fig. 3. This period duration is selected to facilitate use of the MPEG source coder described below; however, the frame period in the system 10 can be set to a different predetermined value. If the period duration is 432 ms, then each 16 kbps PRI requires 16,000 x 0.432 seconds = 6912 bits per frame. As shown in Fig. 3, a broadcast channel therefore consists of a value n of these 16 kbps PRIs which are carried as a group in the frame 100. As will be described below, these bits are scrambled to enhance demodulation at the radio receivers 29. The scrambling operation also provides a mechanism for encrypting the service at the option of the service provider. Each frame 100 is assigned n x 224 bits which correspond to a service control header (SCH) 102, resulting in a total of n x 7136 bits per frame and a bit rate of n x (16,518 +14/27) bits per second. The purpose of the SCH 102 is to send data to each of the radio receivers 29 tuned to receive the broadcast channel 59 or 67 in order to control reception modes for various multimedia services, to display data and images, to send key information for decryption, to address a specific receiver, among other features. The service control header 102 can be provided with information necessary to select Internet information, and to decrypt pay-per-use-type of Internet information.

The sources 60 and 64 are coded using, for example, MPEG 2.5 Layer 3 coders 62 and 66, respectively, as shown in Fig. 2. The two sources are subsequently added via a combiner 76 and then processed using a processor at the broadcast station 26 to provide the coded signals in periodic frames of 432 ms, that is, n x 7136 bits per frame including the SCH, as indicated by processing module 78 in Fig. 2. In addition, information-type identification data can be provided in the SCH of the BC.

The blocks indicated at the broadcast station 26 in Fig. 2 correspond to programmed modules performed by a processor and associated hardware such as digital memory and coder circuits. The bits in the frame 100 are subsequently coded for FEC protection using digital signal processing (DSP) software, application specific integrated circuits (ASICs) and custom large-scale integration (LSI) chips for the two concatenated coding methods. First, a Reed Solomon coder 80a is provided to produce 255 bits for every 223 bits entering the coder. The bits in the frame 100 are then reordered according to a known interleaving scheme, as indicated by reference numeral 80b. The interleaving coding provides further protection

against bursts of error encountered in a transmission since this method spreads damaged bits over several channels. With continued reference to processing module 80, a known convolution coding scheme of constraint length 7 is applied using a Viterbi coder 80c. The Viterbi coder 83c produces two output bits for every input bit, producing as a net result 16320 FEC-coded bits per frame for each increment of 6912 bits per frame applied in the broadcast channel 59. Thus, each FEC-coded broadcast channel (e.g., channel 59 or 67) comprises n x 16320 bits of information which have been coded, reordered and coded again such that the original broadcast 16 kbps PRIs are no longer identifiable. The FEC-coded bits, however, are organized in terms of the original 432 ms frame structure. The overall coding rate for error protection is (255/223) x 2 = 2+64/223.

With continued reference to Fig. 2, the n x 16320 bits of the FEC-coded broadcast channel frame is subsequently subdivided or demultiplexed using a channel distributor 82 into n parallel prime rate channels (PRCs), each carrying 16320 bits in terms of sets of 8160 two-bit symbols. This process is further illustrated in Fig. 3. The broadcast channel 59 is shown which is characterized by a 432 ms frame 100 having an SCH 102. The remaining portion 104 of the frame consists of n 16 kbps PRIs which corresponds to 6912 bits per frame for each of the n PRIs. The FEC-coded broadcast channel 106 is attained following concatenated Reed Solomon 255/223, interleaving and FEC 1/2 convolution coding described above in connection with module 80.

As stated previously, the FEC-coded broadcast channel frame 106 comprises n x 16320 bits which correspond to 8160 sets of two-bit symbols, with each symbol being designated by a reference numeral 108 for illustrated purposes. In accordance with the present invention, the symbols are assigned across the PRCs 110 in the manner shown in Fig. 3. Thus, the symbols are spread on the basis of time and frequency which further reduces errors at the radio receiver 21 that are caused by interference in transmission. The service provider for broadcast channel 59 has purchased four PRCs for illustrative purposes, whereas the service provider for broadcast channel 67 has purchased six PRCs for illustrative purposes. Fig. 3 illustrates the first broadcast channel 59 and the assignment of symbols 114 across the n = 4 PRCs 110a, 110b, 110c and 110d, respectively. To implement recovery of each two-bit symbol 114 set at the receiver, a PRC synchronization header or preamble 112a, 112b, 112c and 112d, respectively, is placed in front of each PRC. The PRC synchronization

header (hereinafter generally referred to using reference numeral 112) contains 48 symbols. The PRC synchronization header 112 is placed in front of each group of 8160 symbols, thereby increasing the number of symbols per 432 ms frame to 8208 symbols. Accordingly, the symbol rate becomes 8208/0.432 which equals 19,000 kilosymbols per second (ksym/s) for each PRC 110. The 48 symbol PRC preamble 112 is used essentially for synchronization of the radio receiver PRC clock to recover the symbols from the downlink satellite transmission 27. At the on-board processor 116, the PRC preamble is used to absorb timing differences between the symbol rates of arriving uplink signals and that used on-board to switch the signals and assemble the downlink TDM streams. This is done by adding a "0" to or subtracting a "0" from each 48 symbol PRC, or abstaining from both operations, in the rate alignment process used on-board the satellite 20. Thus, the PRC preambles carried on the TDM downlink has 47, 48 or 49 symbols as determined by the rate alignment process. As shown in Fig. 3, symbols 114 are assigned to consecutive PRCs in a round-robin fashion such that symbol 1 is assigned to PRC 110a, symbol 2 is assigned to PRC 110b, symbol 3 is assigned to PRC 110c, symbol 4 is assigned to PRC 110d, symbol 5 is assigned to PRC 110a, and so on. This PRC demultiplexing process is performed by a processor at the broadcast station 26 and is represented in Fig. 2 as the channel distribution (DEMUX) module 82.

The PRC channel preambles are assigned to mark the beginning of the PRC frames 110a, 110b, 110c and 110d for broadcast channel 59 using the preamble module 84 and adder module 85. The n PRCs are subsequently differentially encoded and then QPSK modulated onto an IF carrier frequency using a bank of QPSK modulators 86 as shown in Fig. 2. Four of the QPSK modulators 86a, 86b, 86c and 86d are used for respective PRCs 110a, 110b, 110c and 110d for broadcast channel 59. Accordingly, there are four PRC IF carrier frequencies constituting the broadcast channel 59. Each of the four carrier frequencies is up-converted to its assigned frequency location in the X-band using an up-converter 88 for transmission to the satellite 20. The up-converted PRCs are subsequently transmitted through an amplifier 90 to the antenna (e.g., a VSAT) 92a and 92b.

The SCH 102 inserted into each coded PRC preferably comprises a control word to identify the program channel to which the PRC belongs and to carry instructions that allow the receiver to recombine the coded prime rate channels to reconstruct the coded program channels. An exemplary eighty (80) bit control word is:

# Bits	Indication
2	Quantity Of Related Ensembles (00 = no relation, four related ensembles maximum)
2	Ensemble Identification Number (00=Ensemble #1, 11=Ensemble 4)
4	Ensemble Type (0000=Audio, 0001=Video, 0010=Data, other types or reserved)
3	Quantity Of 16 kbps Prime Rate Channels In Ensemble (000=1 channel, 001=2 channels, ..., 111=8 channels)
3	Prime Rate Channel Identification Number (000=channel 1, ..., 111=channel 8)
3	Quantity Of Sub-Ensembles (000=1, ..., 111=8)
3	Quantity Of 16 kbps Prime Rate Channels In Sub-Ensemble (000=1, ..., 111=8)
2	Sub-Ensemble Identification Number (000=Ensemble #1, ..., 111=Ensemble 8)
3	Ensemble/Sub-Ensemble Blocking (000=no blocking, 001=type 1 blocking, ..., 111=type 7 blocking)
11	Reserved
40	CRC.

The control word entry for the Quantity of Related Ensembles allows a relationship to be created between various groups of ensembles. For example, a broadcaster may wish to provide related audio, video and data services, such as electronic newspaper with audio text, and additional information. The Ensemble Identification Number identifies the ensemble number of which the channel is a part. The Quantity Of 16 kbps Prime Rate Channels In Ensemble defines the number of prime rate channels in the ensemble. The Quantity Of Sub-Ensembles and Quantity of 16 kbps Prime Rate Channels In Sub-Ensemble defines a relationship within an ensemble, such as, in a CD quality stereo ensemble, use of four prime rate channels for a "Left Stereo" signal and four different prime rate channels for a "Right Stereo" signal. Alternatively, music may be associated with multiple voice signals for announcers, each voice signal in a different language. The Quantity Of 16 kbps Prime Rate

Channels In Sub-Ensemble defines the number of prime rate channels in the sub-ensemble. The Sub-Ensemble Identification Number identifies the sub-ensemble of which the channel is a part.

The Ensemble/Sub-Ensemble Blocking bits allow cooperative blocking of broadcast information. For instance, some countries may prohibit advertising for alcohol. User terminals 22 produced for that country can be preset with a code, or a code can otherwise be loaded, so that the user terminals respond to the blocking signal and block the specific information. The blocking function can also be used to restrict the dissemination of sensitive information (such as military or governmental information), or to restrict revenue-bearing broadcast services to certain users.

As stated previously, each coded program source is divided into individual prime rate channels. As an example, an audio source may comprise four prime rate channels, which represents an FM quality stereo signal. Alternatively, an audio source may comprise six prime rate channels, which can be used as a "near CD" quality stereo signal, or an FM quality stereo signal linked to a 32 bit data channel (e.g., for transmitting a signal for display on a radio receiver liquid crystal display (LCD)). As a further alternative, the six prime rate channels can be used as a 96 kbps broadcast data channel. The image source may comprise only one 16 kbps channel or several channels. As will be described in further detail below, user terminals 22, relying on ensemble information included in the TDM frame and in each prime rate channel, preferably automatically select those prime rate channels necessary to generate the user-selected digital audio program or other digital service program.

In accordance with the present invention, the transmission method employed at a broadcast station 26 incorporates a multiplicity of n Single Channel Per Carrier, Frequency Division Multiple Access (SCPC/FDMA) carriers into the uplink 28. These SCPC/FDMA carriers are spaced on a grid of center frequencies which are preferably separated by 38,000 Hertz (Hz) from one another and are organized in groups of 48 contiguous center frequencies or carrier channels. Organization of these groups of 48 carrier channels is useful to prepare for demultiplexing and demodulation processing conducted on-board the satellite 20. The various groups of 48 carrier channels are not necessarily contiguous to one another. The carriers associated with a particular broadcast channel (i.e., channel 59 or 67) are not necessarily contiguous within a group of 48 carrier channels and need not be assigned in the

same group of 48 carrier channels: The transmission method described in connection with Figs. 2 and 3 therefore allows for flexibility in choosing frequency locations and optimizes the ability to fill the available frequency spectrum and to avoid interference with other users sharing the same radio frequency spectrum.

Fig. 1 illustrates the overall operation of a system 10 for broadcasting Internet information, as well as other broadcast programs, in accordance with a preferred embodiment of the present invention. In the case of the satellite processing payload, uplink signals 28 issue from broadcasters via individual frequency division multiple access (FDMA) channels from broadcast stations 26 located anywhere within the terrestrial visibility of the satellite 20 with elevation angles higher than 10°. Each broadcaster has the ability to uplink directly from its own facilities to one of the satellites 20 by placing one or more 16 kbps prime rate channels on the FDMA carriers. Alternatively, broadcasters which have no capacity for direct access to the satellite 20 may have access through a hub station. For example, the system gateway 23 can broadcast Web pages directly to one of the direct radio broadcast satellites 20 or indirectly via a hub 27. Use of FDMA for the uplink 28 offers the highest possible flexibility between multiple independent broadcast stations.

III. Satellite

The preferred satellites 20 of the direct radio broadcast system 10 cover the African-Arabian region, the Asian region and the Caribbean and Latin American regions from the following geostationary orbits:

- 21°E orbital location, providing service to Africa and the Middle East.
- 95°W orbital location, providing service to Central and South America.
- 105°W orbital location, providing service to Southeast Asia and the Pacific rim.

Coverage for other areas, such as North America and Europe, can be provided with additional satellites.

The direct radio broadcast system preferably uses the frequency band of 1467 to 1492 MHz, which has been allocated for Broadcasting Satellite Service (BSS) Direct Audio

Broadcast (DAB) at WARC 92, that is, in accordance with resolutions 33 and 528 of the ITU. The broadcasters 26 use feeder uplinks in X band, from 7050 to 7075 MHz. Each satellite 20 is preferably equipped with three downlink spot beams, having beamwidths of about 6°. Each beam covers approximately 14 million square kilometers within power distribution contours that are 4 dB down from beam center and 28 million square kilometers within contours that are 8 dB down. The beam center margin may be 14 dB based on a receiver gain-to-temperature ratio of -13 dB/K.

Each satellite 20 carries two types of payloads. One is a "processing" payload that regenerates the uplink signals 28 and assembles 3 TDM downlink carriers, and the other is a "transparent" payload that repeats the uplink signals on 3 TDM downlink carriers 30. The TDM signals 30 from the two payloads are each transmitted in 3 beams, with the processed and transparent signals in each beam having opposite circular polarization (LHCP and RHCP). Each TDM downlink signal 30 carries 96 prime rate channels in assigned time slots. To a user terminal 22, all of the TDM downlink signals 30 appear the same, except for carrier frequency. The total capacity per satellite is 2 x 3 x 96 = 576 prime rate channels.

Conversion between uplink FDMA signals 28 and downlink multiple-channel-per-carrier, time division multiplex (MCPC/TDM) signals 30 in the direct radio broadcast system of Fig. 1 is achieved on board the satellite 20 by an on-board processor. At the satellite 20, each prime rate channel transmitted by a broadcast station 26 is demultiplexed and demodulated into individual 16 kbps baseband signals. Individual channels are routed via a switch to one or more of the downlink beams 30, each of which is a single TDM signal. This baseband processing provides a high level of channel control in terms of uplink frequency allocation and channel routing between uplink and downlink. Uplink signals are received in the satellite in X band and converted to L band by the on-board processor. The downlinks 30 to the user terminals 22 use MCPC/TDM carriers. One such carrier is used in each of the three beams on each satellite 20. The manner in which the direct radio broadcast system formats the FDMA uplinks and performs payload processing to generate the TDM downlinks permits reception of a significant amount of data, including high sound quality audio programs, using low cost receivers, among other advantages.

For the transparent payload, the TDM signals are assembled at a broadcast station and appear in precisely the same structure as do those assembled on board the satellite 20 by the

processing payload. The TDM signal is sent to the satellite in the X band and is repeated in the L band in one of the three downlink beams. The power level is the same for downlink TDM signals generated by the processing payload. Thus, the technique for providing digital delivery of all information services (e.g., voice, music, data, images and multimedia information which can be obtained from the Internet) described herein and in accordance with the present invention is applicable to both the on-board processing and transparent payloads. Processing such as the routing performed on-board the satellite 20 can occur at an earth station when using the transparent payload.

Fig. 4 illustrates the on-board re-allocation of prime rate channels from uplink frequency division multiple access channels into a downlink MCPC/TDM channel in the processing payload of the satellite 20 of Fig. 1. The overall uplink capacity is preferably between two hundred eighty-eight (288) and three hundred eighty-four (384) prime rate uplink channels 116 of 16.519 kbps each. Ninety-six (96) prime rate channels 118 are selected and multiplexed for transmission in each downlink beam 30, and time division multiplexed onto a carrier of approximately 2.5 MHz bandwidth as indicated at 120. Each uplink channel is routed to all, some or none of the downlink beams. The order and placement of prime rate channels in a downlink beam is fully selectable via a command link from a telemetry, range and control (TRC) facility 38, which is shown in Fig. 1.

Software is preferably provided at a broadcast station 26 or, if more than one broadcast station 26 exists in the system 10, in a regional broadcast control facility (RBCF) 39 to assign space segment channels in the uplink beam 28 to a satellite 20. The RBCF 39 is preferably connected to the TRC facility 38 via a communication link. The software optimizes use of the uplink spectrum by assigning PRC carriers whenever space is available in the 48 channel groups. The carriers associated with a particular broadcast channel need not be continuous within a group of 48 carrier channels and need not be assigned in the same group of 48 carrier channels.

The carrier frequencies in each downlink beam 30 are different to enhance beam-to-beam isolation. Each TDM downlink channel is operated in the satellite payload at saturation, giving the highest possible power efficiency in terms of link performance. Use of single carrier per transponder operation achieves maximum efficiency in the operation of the satellite communication payload in terms of conversion of solar power into radio frequency

power. This is far more efficient than techniques requiring simultaneous amplification of a multiplicity of FDM carriers. The system produces high receive margins suitable for stationary and mobile reception indoors and outdoors.

The system 10 carries out audio source coding using MPEG 2.5, Layer 3 which achieves the cited qualities at bit rates of 16, 32, 64 and 128 kbps, respectively, and also includes the capability to perform 8 kbps coding. Image coding is carried out using the JPEG standard. Error rates over the system are less than 10^{-10} and thus are suitable for high quality digital image and data transmission for multimedia services. The MPEG 2.5, Layer 3 coding offers a better bit rate efficiency than the previous MPEG 1, Layer 2 (Musicam) or MPEG 2 standards for the same audio quality. For audio broadcasts, the digitally coded source bit rates are:

- 8 kbps for utility monophonic voice;
- 16 kbps for non-utility monophonic voice;
- 32 kbps for monophonic music, with near FM quality;
- 64 kbps for stereophonic music, with near FM quality; and
- 128 kbps for stereophonic music, with near CD quality.

In the preferred implementation of the satellite direct radio broadcast system, each satellite 20 has the capacity to transmit a total of 3072 kbps per beam (including the 2 TDM carriers for the processing and transparent payloads, respectively), which may be any combination of the above audio services. This corresponds to a capacity per beam of:

- 192 monophonic voice channels; or
- 96 monophonic music channels; or
- 48 stereophonic music channels; or
- 24 CD stereophonic music channels; or
- any combination of the above signal qualities.

Since the system 10 provides direct digital channels for digital delivery of broadcast services, the system 10 can broadcast any type of data, images, moving images and other multimedia data via the satellites 20 such as information obtained from the Internet and multimedia sources, as well as voice and music. In accordance with an aspect of the present invention,

the system 10 can deliver to user terminals 22 push Internet information, that is, Internet information which is transmitted via the satellites 20 without requiring acknowledgment from the user.

The overall satellite direct radio broadcast system delivers the digital signals with a bit error rate (BER) of 10^{-4} or better, providing the various service qualities previously defined. For each downlink beam 30 in L band transmitted by the satellites 20, the Edge Of Coverage EIRP of the TDM carrier is 49.5 dBW. This EIRP, together with specific Forward Error Correction, insures a minimum 9 dB margin for a 10^{-4} BER, using the baseline radio receiver antenna. This margin helps combat signal loss due to obstacles in the path between the satellite 20 and the receiver at the user terminal 22, providing full quality reception in the intended coverage area.

User terminals 22 in obstructed locations can be connected to a high gain antenna, or to an antenna located in an unobstructed position. For example, reception in large buildings may need a common roof antenna with indoor retransmission for the entire building, or individual reception antennas near a window. At the 4 dB down contour of the earth coverages, the channels have an estimated margin of 10 dB relative to the power density needed to deliver a bit error rate of 10^{-4}. At beam center this margin estimate is 14 dB.

The operating margin of the direct radio broadcast system does not change for the higher bit rates. Within the 4 dB contour, most user terminals 22 view the satellite 20 at elevation angles of greater than 60°, making interference from structures virtually nil. In some beams, within the 8 dB contour the elevation angle to the satellite 20 is greater than 50°, which may experience occasional interference due to reflections or blockage from structures. Line of sight reception even at low elevation angles (10° to 50°) is always possible with small 8 dBi gain antennas in some beams pointed toward the horizon.

As stated previously, the direct radio broadcast system includes a baseband processing payload in the satellite 20. Baseband processing allows improved system performance for uplink and downlink link budgets, management of broadcast stations, and control of the downlink signals. Fig. 5 illustrates satellite signal processing in the satellite direct radio broadcast system. The coded prime rate uplink carriers are received at an X-band receiver 122. A polyphase demultiplexer and demodulator 124 receives the 288 individual FDMA signals in 6 groups of 48, generates six analog signals on which the data of the 288 signals is

divided into 6 time multiplexed streams, and performs demodulation of the serial data on each stream. A routing switch and modulator 126 selectively routes individual channels of the serial data into all, some or none of three downlink signals, each carrying 96 channels, and further modulates them onto the three downlink L-band TDM signals. Traveling wave tube amplifiers 128 boost the power of the three downlink signals, which are radiated to earth by L-band transmit antennas 130. The transparent payload also comprises a demultiplexer and downconverter 132 and an amplifier group 134, which are configured in a conventional "bent pipe" signal path to frequency convert uplink TDM/MCPC signals for retransmission at L band.

The satellites 20 are operated by a ground control segment (e.g., the software available at a single broadcast station 26 or a RBCF 39 servicing a number of broadcast stations 26) and managed according to traffic requirements by a mission control segment during the orbit lifetime. The bit rates and consequently the service qualities can be mixed in any beam to meet the demand for service. The bit-rate/quality complexion of a service can be easily changed from ground command and can vary at different times of the day. In the preferred embodiment, channel allocation can be changed on an hour-by-hour basis according to a program schedule established twenty-four hours in advance. It is to be understood, however, that channel allocation can be changed on a more or less frequent basis.

With reference to Fig. 2, within each QPSK modulation block 86, a separate QPSK modulator modulates each prime rate channel to an intermediate frequency. The upconverter 88 moves the separate prime rate channels to the FDMA uplink band, and the upconverted channels are transmitted through amplifier 90 and antenna 91. Broadcast uplink stations preferably use VSAT signals for transmission of elementary (16 kbps) channels, using small antennas (2 to 3 meters in diameter).

The prime rate uplink channels are transmitted to the satellite 20 on individual FDMA carriers. As stated previously, up to 288 uplink prime rate carriers can be transmitted to the satellite 20 in its global uplink beam. Small broadcasters' earth terminals equipped with 2.4 meter diameter parabolic X-band antennas and 25 watt power amplifiers can easily transmit a 128 kilobit per second program channel (comprising 8 of the prime rate channels) to the satellite 20 from a site in the country originating the program. Alternatively, program channels can be connected to shared uplink earth terminals via leased PSTN

terrestrial links. The system has adequate uplink capacity for every country in its world coverage to have its own satellite radio broadcasting channel.

IV. User Terminals

A block diagram of one of the user terminals 22 of Fig. 1 is provided in Fig. 6. The user terminal 22 receives the L band signal from the satellite 20, demodulates and extracts from the TDM stream the useful audio, data or image signal, and reproduces the desired audio data or image information. The user terminal may be equipped with a small compact patch antenna 136 having about 4 to 6 dBi gain, which will require virtually no pointing. The user terminal 22 tunes automatically to selected channels.

As stated previously, time division multiplexed, multiple channel per carrier techniques (MCPC/TDM) are used for downlink transmission to the user terminal 22. Each of the prime rate channels occupies its own time slot in the time division stream. These prime rate channels are combined to carry program channels ranging from 16 to 128 kilobits per second. Use of digital techniques allows for ancillary services to the radio including low rate video, paging, mailing, fax, use of flat display screens, or serial data interfaces. This data and information may be multiplexed within the audio digital signal channels. In addition, the prime rate channels can carry program channels that are primarily screens (e.g., a homepage from the WWW) for display at the user terminal with or without an audio program, and downloaded data for storage and/or printing.

Each user terminal 22 can tune to one of the TDM carriers transmitted in one of the beam coverages. As shown in Fig. 6, the user terminal 22 includes a digital broadcast receiver 21, an antenna 136, and a computer 29. The receiver 21 can be connected to a serial port of the computer 29, for example. An Internet service provider such as the system gateway 23 of Fig. 1 can operate in one, two or all of the beam coverages of the three satellites 20. The system 10 can change the FDM uplinks 28 assigned to an Internet service provider and the manner in which the information is routed on-board the satellite 20 to one or more of the downlink beams 30 via software and telemetry control.

Within the digital broadcast receiver 21, a low noise amplifier 138 boosts the satellite signal, and the boosted signal is received by an RF front end and QPSK demodulator 140. The output of the RF front end and QPSK demodulator 140 can be connected to a first time

division demultiplexer 142 which recovers the audio prime rate channels (PRCs), and to a second time division demultiplexer 144 which recovers the prime rate channels carrying data, including images.

After the n PRCs of a received broadcast channel are realigned, the symbols of each PRC are remultiplexed into an FEC-coded broadcast channel using blocks 142 and 144. The output of the block 142 is a baseband digital signal carrying audio information, and the output of the block 144 is a baseband digital signal carrying data.

The recombined coded program channels thus recovered are decoded and deinterleaved to recover the original baseband prime rate bit stream that entered the system at the broadcaster's earth station 26. In the case of audio data, the recovered bit streams are converted back to an analog audio signal by an audio decoder 146 and a digital-to-analog converter 148. The analog signal is boosted by an amplifier 150 and is reproduced by a loudspeaker 152. The user terminal can reproduce various audio qualities ranging from AM monaural to CD stereo depending on the program channel bit rate. In the case of data, the recovered bit streams can be converted to a displayable format by an data/image decoder 154. In addition to being displayed, the received data can be saved to a memory device or printed.

The instructions needed for the user terminal 22 to control recombination of the coded prime rate channels into the coded program channels are preferably contained in the control words embedded in each coded prime rate channel and in the original baseband prime rate bit stream (e.g., in the SCH or the PRC preamble). The receiver 21 is programmed to process the instructions in the control words.

In accordance with one embodiment of the present invention, a SCH 102 is provided in each BC, as shown in Fig. 3. Data from the data decoder 154, including the broadcast channel and the SCH, is provided via a broadcast channel input/output (BCIO) port to the computer 29. The computer 29 stores the data on a disk drive 176 (Fig. 6). The computer processes the data to examine the packets. Packet information is compared with user selections made using the keypad 170, mouse 174 or other input device connected to the computer 29 to determine which of the stored packets are to be used for output purposes. The information identification data can be provided as part of the service control headers 102 identifies packets originating from the same Internet source.

The principal components of the computer 29 include a microprocessor 156 having suitable amounts of random access memory (RAM) 160 and read-only memory (ROM) 162, a real-time clock 164 and a display controller 166. The display controller 166 controls the formatting of image data (e.g., Web page data) to a display 168. The microprocessor 156 is preferably also connected to a keypad 170, a printer/plotter 172, a mouse 174 and a disk drive 176. A microprocessor input/output (I/O) interface 158 is illustrated to represent the serial and parallel ports of the microprocessor 156. As shown in Fig. 6, the data decoded by the receiver 21 can be provided to the computer 29 via a serial port connection. The keypad 170 and the mouse 172 are used for selecting broadcast programs, controlling sound levels, making menu selections, and similar functions. Menus and screens can be generated on the display 168 in accordance with program code for the microprocessor 156 or a received Web page. The printer/plotter 172 allows the user to receive a hard copy output of any received data (including images), in addition to viewing the data on the display 168. Finally, the disk drive 176 allows data or programs to be loaded into the computer 29, and also allows received data (e.g., Web pages) to be stored for later viewing, and listening and printing. Another possible function of the disk drive 176 may be, for example, to allow the computer 29 to merge images or other data that are being received in real-time by the digital broadcast receiver 21 with preexisting data stored on a magnetic diskette. This is useful, for example, in allowing an existing image or other data to be updated by transmitting only the new or modified information, without requiring the existing image or data to be retransmitted.

The components of Fig. 6 can be incorporated into a single unit that is designed for portable or mobile use. Alternatively, as shown in Fig. 1, the receiver 21 can be a portable device connected to a separate computer 29. Power may be provided by batteries, solar cells or a generator driven by a spring motor or hand crank. If the user terminal 22 is carried by vehicle such as a boat, aircraft or automobile, power may be provided by the vehicle's power supply. As an alternative to housing all of the components of the user terminal 22 in a single case, the user terminal 22 may be made up of a system or network of separate components interconnected by suitable cables.

Fig. 7 is a flow chart which summarizes the basic series of operations carried out by the user terminal 22 of Fig. 5 when audio and data programs are received. It will be understood that, due to the TDM format of the downlink channels 30, the user terminal 22 is

capable of receiving and reproducing audio programs and data simultaneously. Thus, the user is not required to stop listening to an audio program in order to receive images or other types of data. As a result, a user who wishes to obtain selected data from the Internet, for example, can do so while continuing to listen to audio programs on the audio program channel.

With specific reference now to the logic sequence shown in Fig. 7, the first step in the program is to power-up and initialize the receiver 21 and the computer 29 (block 180). The receiver 21 is tuned to receive one of the three TDM downlinks 30 (block 182). The receiver demultiplexes and decodes prime rate channels from the received downlink 30 and remultiplexes them into a broadcast channel including its SCH 102. The broadcast channel can comprise a real-time audio and video programs. The user terminal commences playback of the audio program on the speaker 152, and display of the video program on the display 168 (block 184). The broadcast channel can also contain Internet information which is stored for use in non-real-time on the disk drive 176. The computer 29 generates a screen 220, which is illustrated in Fig. 8, on the display 168 (block 186). The screen 220 is an initial browser screen which provides the user with a list of different topics of information derived from the Internet broadcast.

The screen 220 can provide an icon and corresponding name for such topics of information as new reports, weather, stock market rates, consumer catalogs, geographical maps, and so on. The user can select one of the topics using the keypad 170, the mouse 174 or other input device (block 188).

In accordance with a preferred embodiment of the present invention, stored information identifying the type of packet data obtained from the SCH 102 is processed by the computer 29 to select and display the type of Internet information selected by the user (blocks 190 and 192). As indicated by the affirmative branch of decision block 194 and block 196, the computer extracts the packets matching the user's selection and generates a screen on the display 168 in accordance with the packets (block 198). For example, the packets can comprise data to create a Web page or a simple computer screen with text and no graphics, or video data. In addition, some of the packets can comprise a sound byte which can be provided to an auxiliary speaker 178 that is connected directly to the computer. If the selected data is accompanied by a sound byte, playback of the audio program via the speaker

152 can be simultaneous with the playback the sound byte. Packets whose information identification data do not correspond to the user selection in the screen 220 are ignored by the computer 29 (block 196).

The topics of information currently stored on the disk drive 176 are displayed on the screen 220. In the meantime, the disk drive 176 can store a new set of Internet information that is currently being received for later viewing by the user. Thus, the disk drive stores new Internet information, while allowing the user to retrieve and view information that has already been stored. The computer can also store information for later use in real-time applications such as distance learning.

The system 10 of the present invention is advantageous because it provides digital delivery channels for broadcasting voice, music, different types of data such as images and moving images, and multimedia information to remote user terminals. Thus, user terminals having no access to the Internet can receive push Internet information, that is, broadcast Internet information which does not require acknowledgment from the remote user. In accordance with another aspect of the present invention, the user terminal can be provided with a terrestrial link, e.g., a public switched telephone network (PSTN) link, to communicate with an information provider. For example, the user can receive a broadcast educational program comprising voice, text and image data from a distance learning center via a satellite 20. The user can send responses to the educational program to the distance learning center or another site via the PSTN link. This configuration is advantageous when the PSTN link lacks sufficient bandwidth to carry the voice, text and image data of the program.

Although the present invention has been described with reference to a preferred embodiment thereof, it will be understood that the invention is not limited to the details thereof. Various substitutions and modifications have been suggested in the foregoing description, and others will occur to those of ordinary skill in the art. All such substitutions and modifications are intended to be embraced within the scope of the invention as defined in the appended claims.

What Is Claimed Is

1. A system for providing user terminals with information from at least one remote communication network comprising:

a receiver;

a satellite configured to receive a broadcast channel comprising packets containing said information, said information relating to at least one of a plurality of topics, said broadcast channel comprising data indicating which of said packets correspond to which of said plurality of topics, said satellite being operable to transmit said broadcast channel to said receiver;

a processing device connected to said receiver;

a user input device connected to said processing device; and

a display device connected to said processing device, said processing device being programmable to generate a screen on said display device to prompt a user to select one of said plurality of topics, said receiver being operable to provide said packets to said processing device, said processing device being operable to process an input signal generated by said user input device when said user makes a selection using said screen and to examine said data to determine which of said packets correspond to said input signal, said display device being controlled by said processing device to display said information corresponding to said input signal.

2. A system as claimed in claim 1, further comprising a multimedia device connected to said receiver, said information comprising at least one of data, graphics, static images, moving images text, audio, web pages, and video, said multimedia device being operable to perform at least one of a plurality of operations depending on said input signal comprising displaying at least one of said data, said graphics, said static images, said moving images, said text, said web page and said video and playing said audio.

3. A system as claimed in claim 1, further comprising at least one of an Internet service provider computer and a system gateway connected to said remote communication network, and a broadcast station connected to said at least one of an Internet service provider and a system gateway, said broadcast station being operable receive said information from

said at least one of an Internet service provider and a system gateway, to format said information into said broadcast channel with said data indicating to which of said plurality of topics said packets correspond, and to transmit said broadcast channel to said satellite.

4. A system as claimed in claim 3, further comprising a hub for connecting said broadcast station to said system gateway.

5. A method of broadcasting information from Internet service providers to user terminals comprising a radio receiver and a multimedia device via satellite and without a backhaul link between the user terminals and the service providers:

formatting a broadcast channel comprising packets of Internet information relating to a plurality of topics and identification data for transmission to said user terminals, said identification data identifying which of said plurality of topics said packets correspond;

transmitting said broadcast channel to said user terminals via said satellite;

receiving said broadcast channel at a number of said user terminals;

generating a menu using said multimedia device to list said plurality of topics;

determining a user input signal corresponding to a selection of one of said plurality of topics from said menu;

determining which of said packets corresponds to said user input signal using said identification data; and

outputting said packets corresponding to said user input signal using said multimedia device.

6. A method as claimed in claim 5, wherein said formatting step comprises the step of formatting Internet information comprising at least one of news, weather reports, stock market rates, educational programs and consumer information.

7. A method as claimed in claim 6, wherein said generating step of:

identifying at least one of said news, said weather reports, said stock market rates, said educational programs and said consumer information using said multimedia device as menu options; and

providing a prompt for instructing a user to select one of said menu options.

8. A method as claimed in claim 5, wherein said formatting step further comprises the step of formatting program information indicating said plurality of topics and corresponding broadcast times for reception at said user terminals.

9. A method as claimed in claim 8, wherein said user terminals are programmed to update said menu using said program information.

10. A satellite broadcast communication system for broadcasting Internet information comprising:

a plurality of receivers;

at least one broadcast station for transmitting a broadcast channel comprising packets of different types of Internet information and data identifying which of said packets which of said different types of Internet information; and

a satellite for receiving said broadcast channel and for transmitting said broadcast channel to said plurality of receivers;

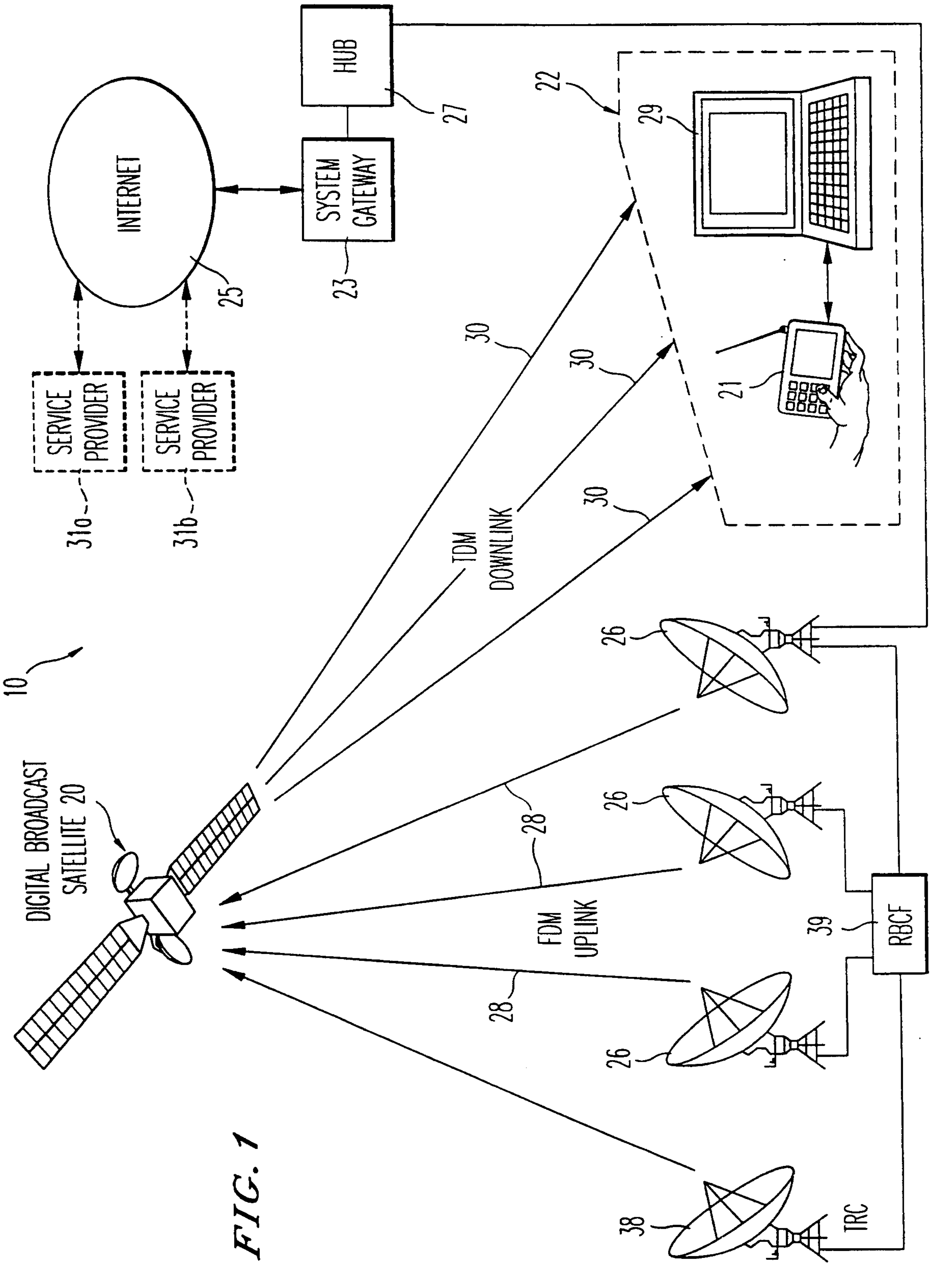
wherein at least one of said plurality of receivers receives said broadcast channel, said receiver comprising a multimedia device having

a memory device for storing packets obtained from said broadcast channel,

an output device for prompting a user to make a selection from a plurality of different types of Internet information;

an input device to allow a user to make said selection, and

a processor programmed to retrieve selected ones of said packets stored in said memory device which correspond to said selection and provide said selected ones of said packets to said output device.



HUB
27
22
29
INTERNET
SYSTEM GATEWAY
23
25
30
30
21
SERVICE PROVIDER
SERVICE PROVIDER
31a
31b
TDM DOWNLINK
30
26
10
DIGITAL BROADCAST SATELLITE 20
26
28
28
FDM UPLINK
39
RBCF
28
26
38
TRC

FIG. 1

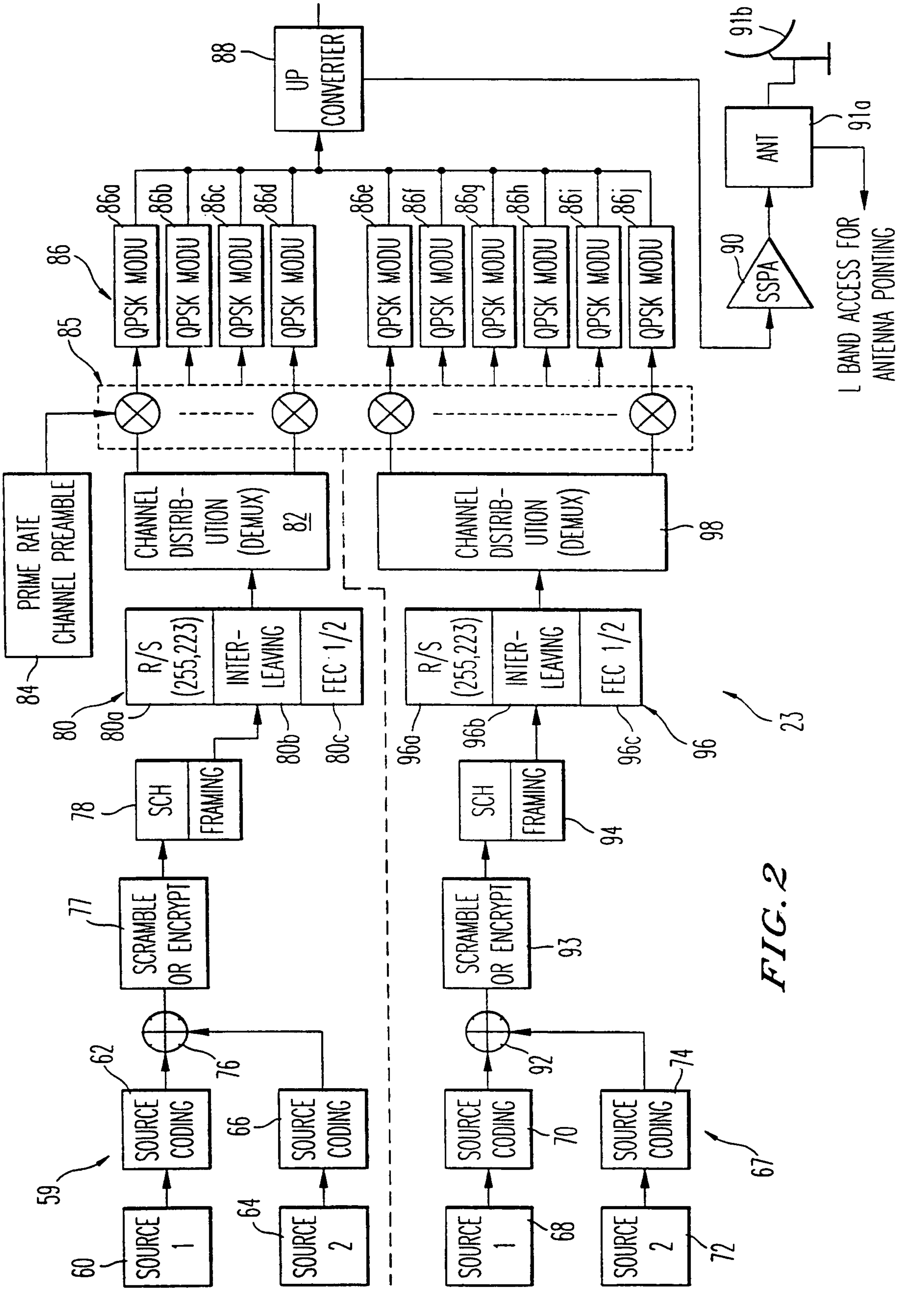

SOURCE 1
SOURCE CODING
SOURCE 2
SOURCE CODING
SCRAMBLE OR ENCRYPT
SCH
FRAMING
R/S (255,223)
INTER-LEAVING
FEC 1/2
CHANNEL DISTRIB-UTION (DEMUX) 82
PRIME RATE CHANNEL PREAMBLE
QPSK MODU
UP CONVERTER
SSPA
ANT
L BAND ACCESS FOR ANTENNA POINTING
59
60
62
64
66
67
68
70
72
74
76
77
78
80
80a
80b
80c
84
85
86
86a
86b
86c
86d
86e
86f
86g
86h
86i
86j
88
90
91a
91b
92
93
94
96
96a
96b
96c
98
23

FIG. 2

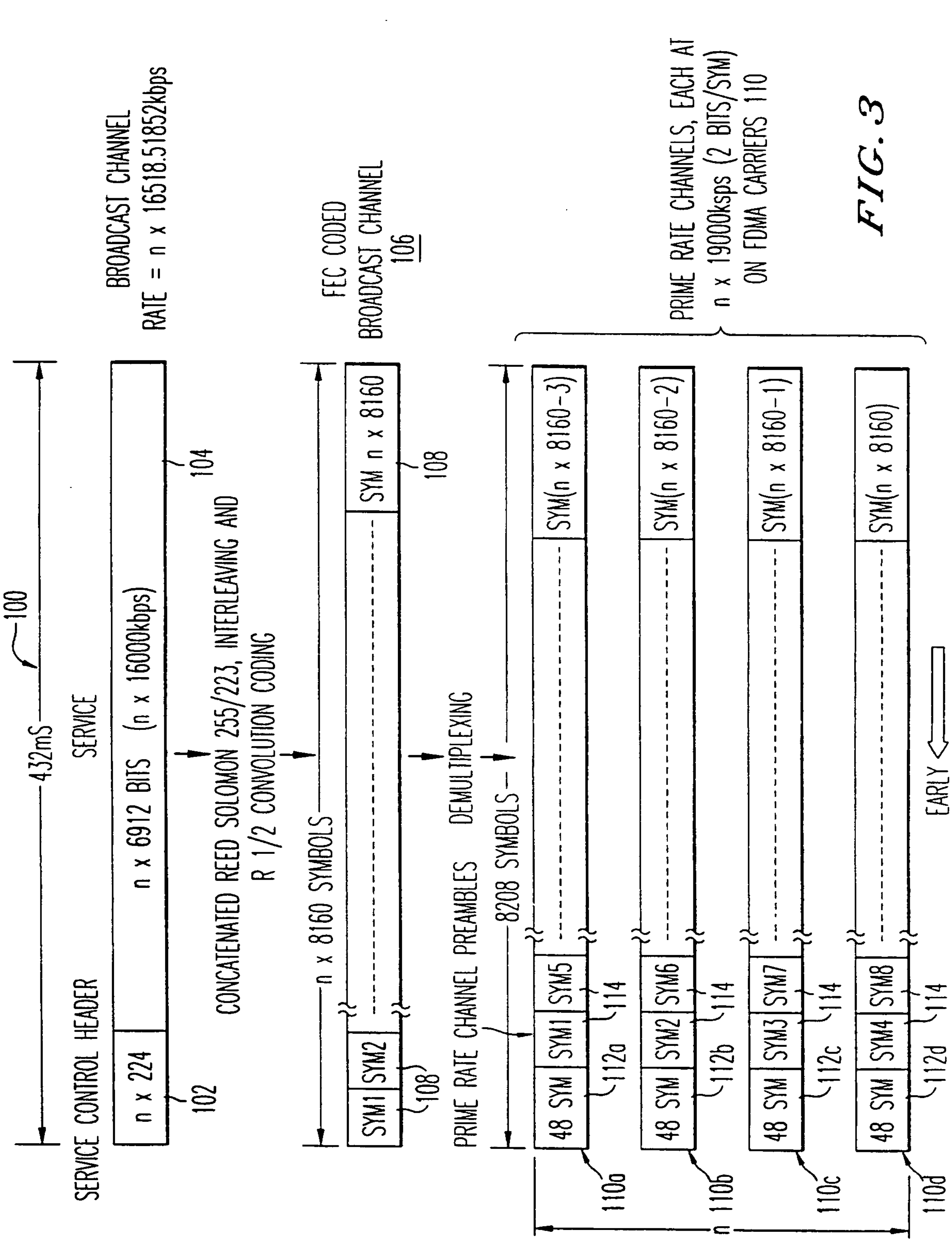

100
432mS
SERVICE CONTROL HEADER
SERVICE
n x 224
n x 6912 BITS (n x 16000kbps)
102
104
BROADCAST CHANNEL
RATE = n x 16518.51852kbps
CONCATENATED REED SOLOMON 255/223, INTERLEAVING AND
R 1/2 CONVOLUTION CODING
n x 8160 SYMBOLS
SYM1
SYM2
SYM n x 8160
108
FEC CODED
BROADCAST CHANNEL
106
DEMULTIPLEXING
PRIME RATE CHANNEL PREAMBLES
8208 SYMBOLS
48 SYM
SYM1
SYM5
SYM(n x 8160-3)
SYM2
SYM6
SYM(n x 8160-2)
SYM3
SYM7
SYM(n x 8160-1)
SYM4
SYM8
SYM(n x 8160)
112a
112b
112c
112d
114
110a
110b
110c
110d
n
EARLY
PRIME RATE CHANNELS, EACH AT
n x 19000ksps (2 BITS/SYM)
ON FDMA CARRIERS 110

FIG. 3

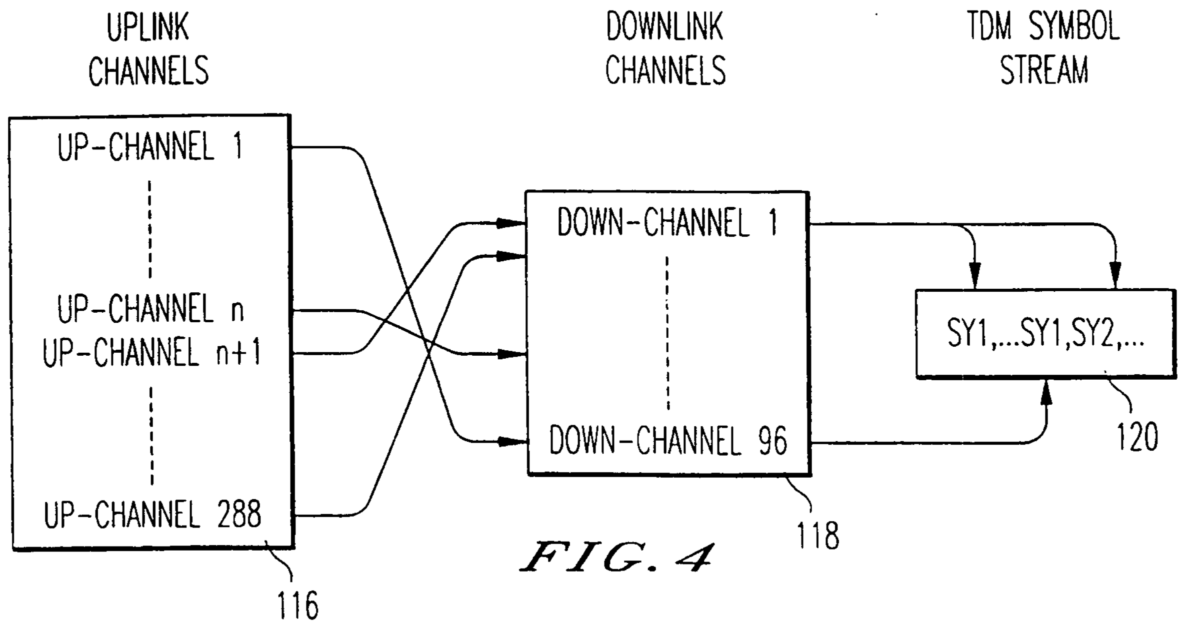

UPLINK CHANNELS
DOWNLINK CHANNELS
TDM SYMBOL STREAM
UP-CHANNEL 1
UP-CHANNEL n
UP-CHANNEL n+1
UP-CHANNEL 288
DOWN-CHANNEL 1
DOWN-CHANNEL 96
SY1,...SY1,SY2,...
120
118
116

FIG. 4

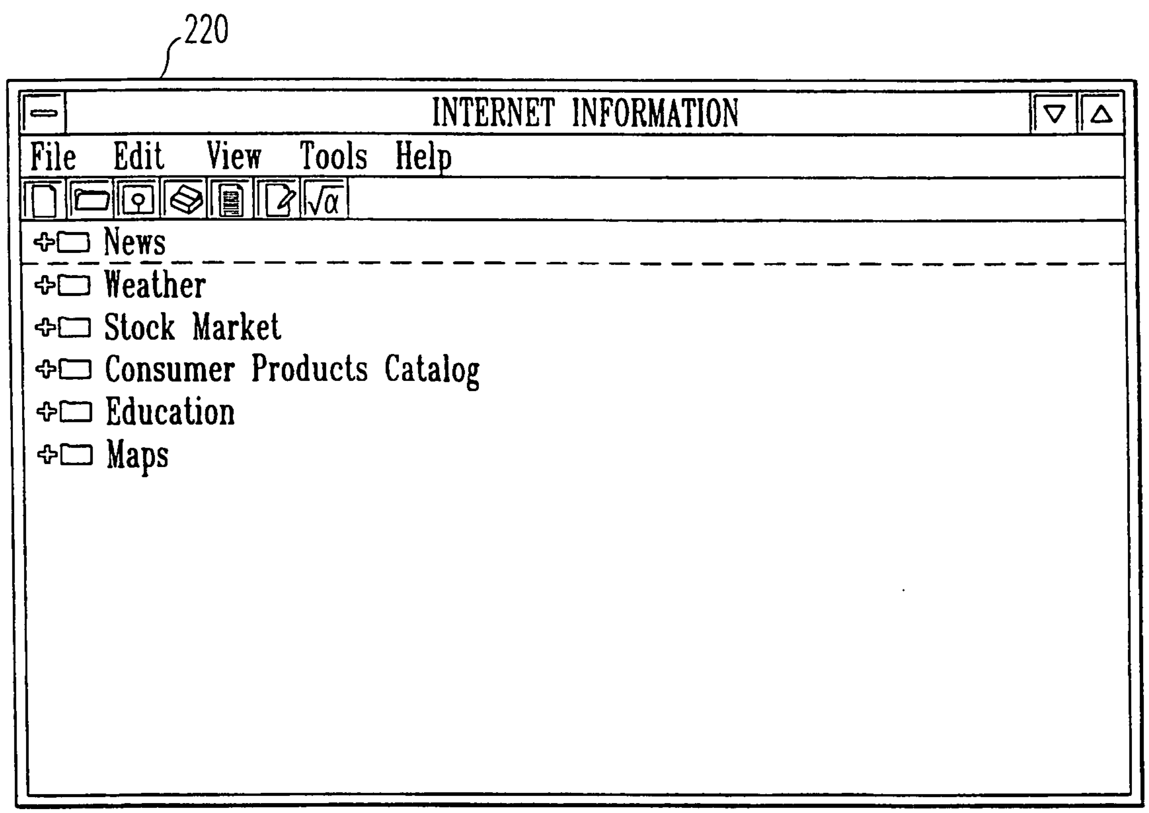

220
INTERNET INFORMATION
File Edit View Tools Help
News
Weather
Stock Market
Consumer Products Catalog
Education
Maps

FIG. 8

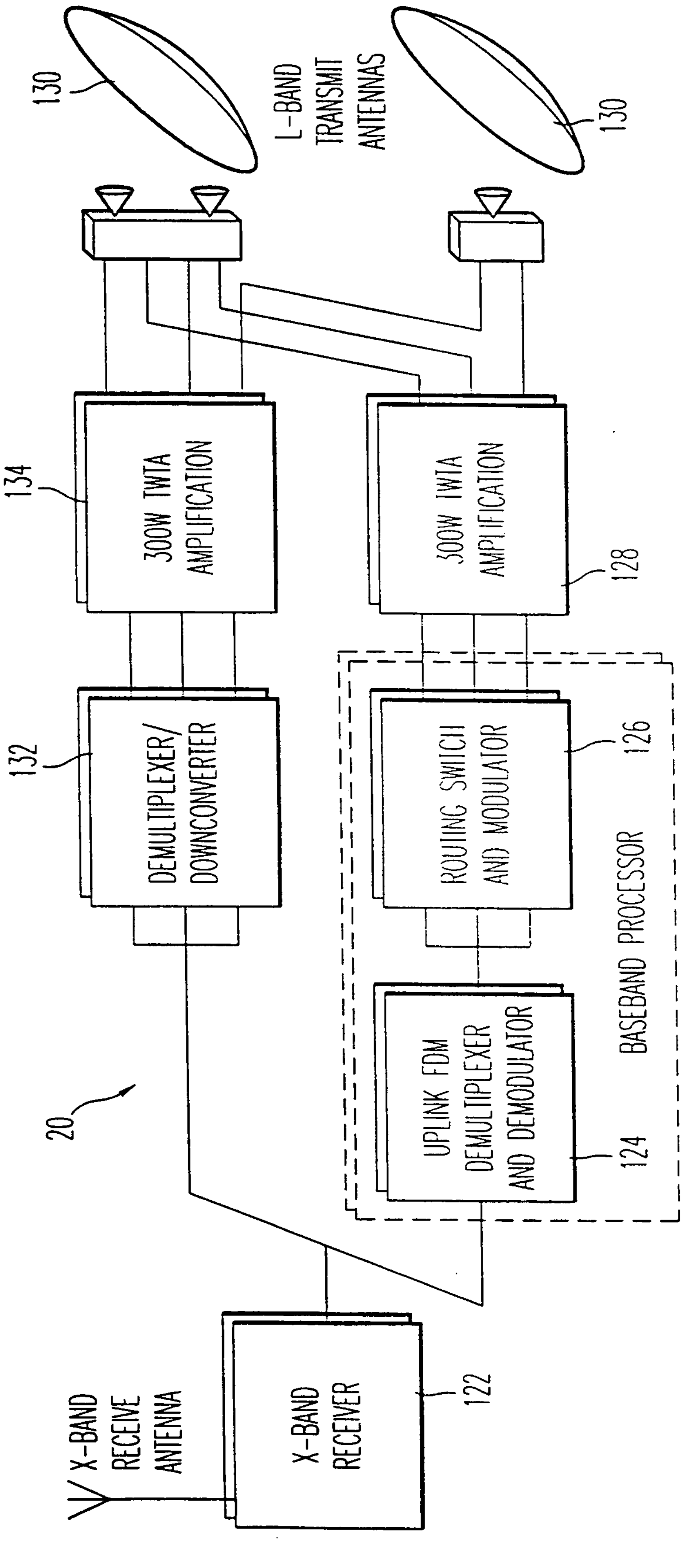

130
L-BAND
TRANSMIT
ANTENNAS
130
134
300W TWTA
AMPLIFICATION
300W TWTA
AMPLIFICATION
128
132
DEMULTIPLEXER/
DOWNCONVERTER
ROUTING SWITCH
AND MODULATOR
126
BASEBAND PROCESSOR
UPLINK FDM
DEMULTIPLEXER
AND DEMODULATOR
124
20
X-BAND
RECEIVE
ANTENNA
X-BAND
RECEIVER
122

FIG. 5

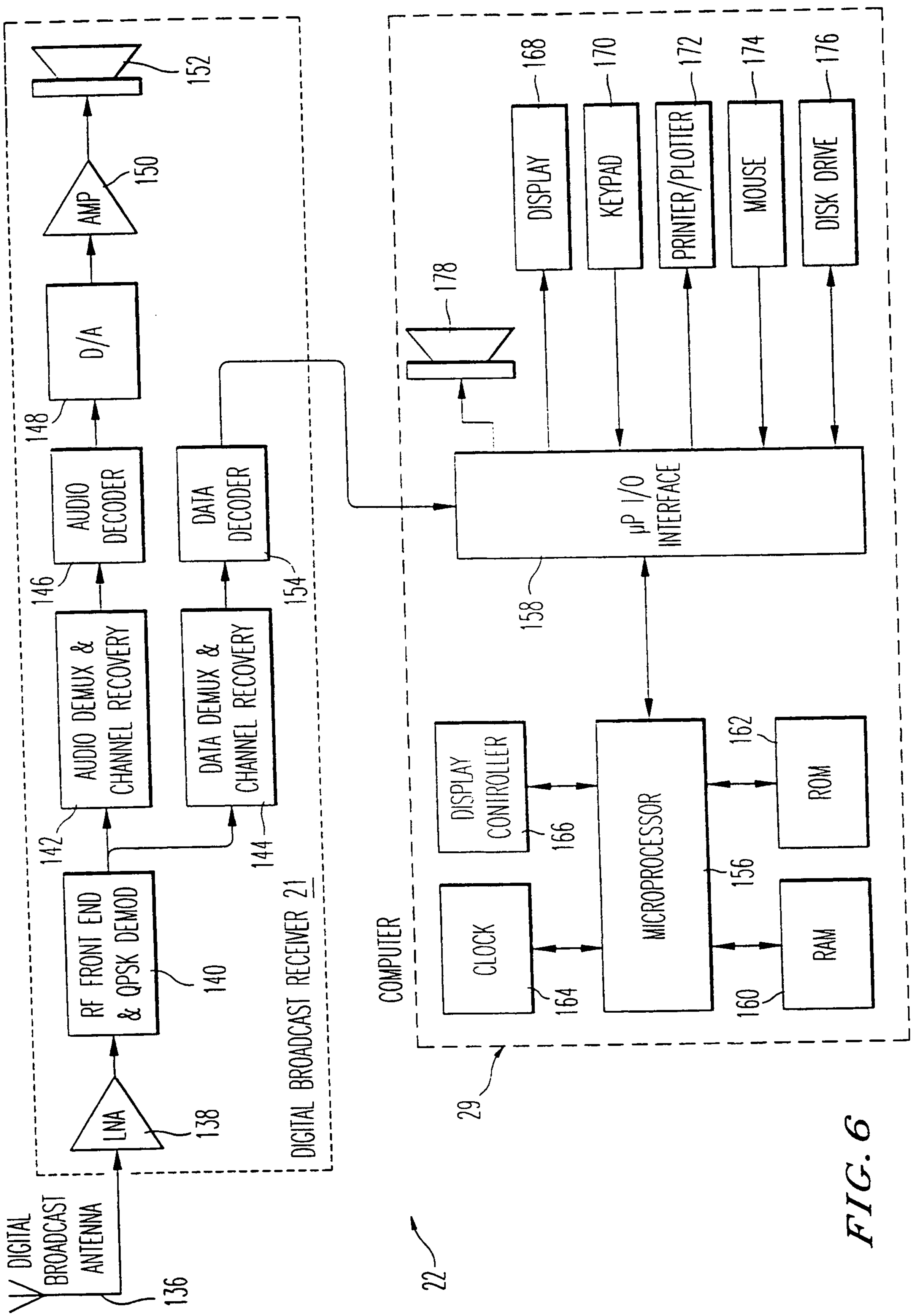

DIGITAL BROADCAST ANTENNA
136
LNA
138
RF FRONT END & QPSK DEMOD
140
AUDIO DEMUX & CHANNEL RECOVERY
142
DATA DEMUX & CHANNEL RECOVERY
144
AUDIO DECODER
146
DATA DECODER
154
D/A
148
AMP
150
152
DIGITAL BROADCAST RECEIVER 21
22
COMPUTER
29
μP I/O INTERFACE
158
178
DISPLAY
168
KEYPAD
170
PRINTER/PLOTTER
172
MOUSE
174
DISK DRIVE
176
DISPLAY CONTROLLER
166
CLOCK
164
MICROPROCESSOR
156
ROM
162
RAM
160

FIG. 6

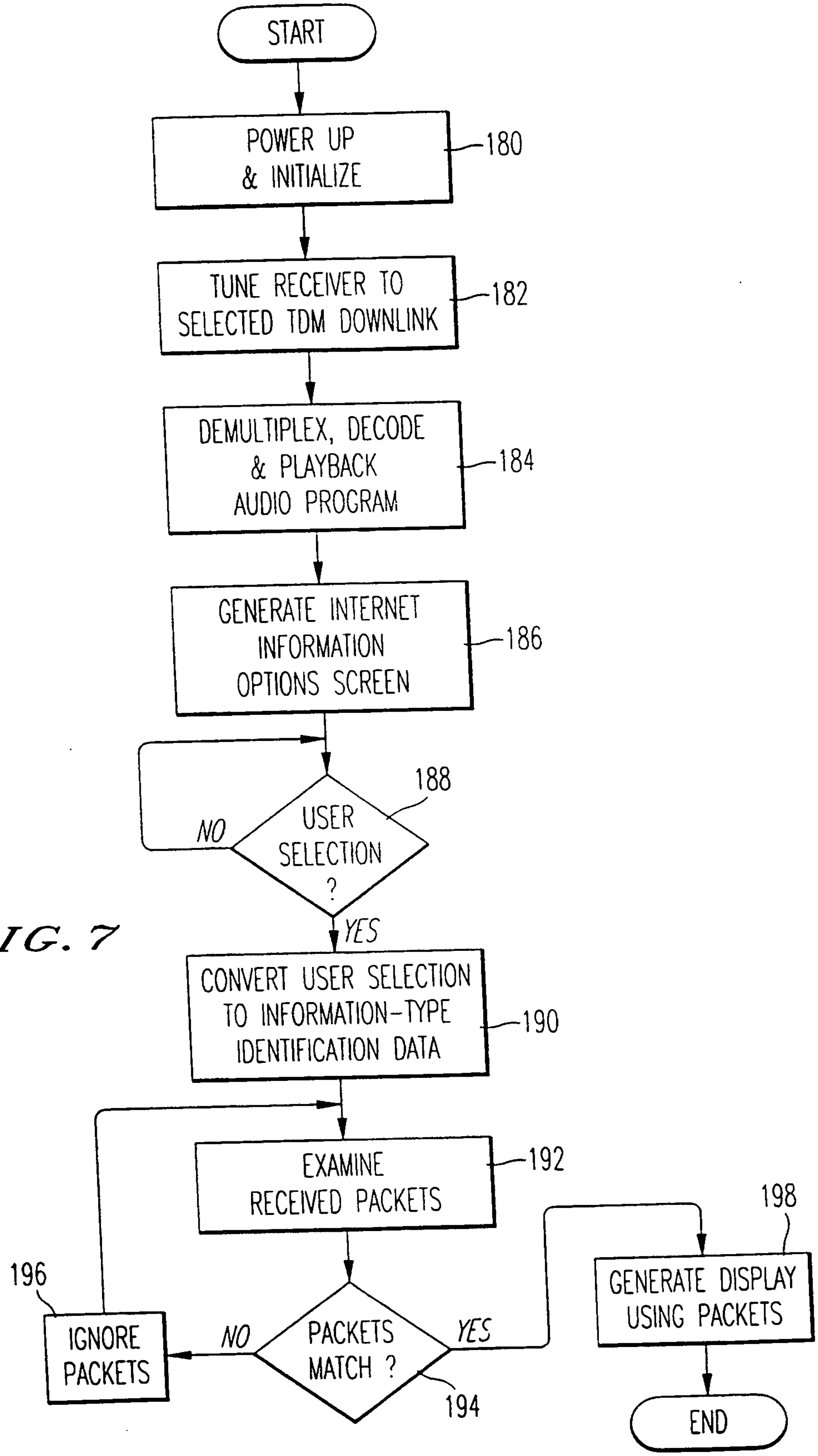

START
POWER UP & INITIALIZE
180
TUNE RECEIVER TO SELECTED TDM DOWNLINK
182
DEMULTIPLEX, DECODE & PLAYBACK AUDIO PROGRAM
184
GENERATE INTERNET INFORMATION OPTIONS SCREEN
186
188
NO
USER SELECTION ?
YES
CONVERT USER SELECTION TO INFORMATION-TYPE IDENTIFICATION DATA
190
EXAMINE RECEIVED PACKETS
192
198
196
IGNORE PACKETS
NO
PACKETS MATCH ?
YES
194
GENERATE DISPLAY USING PACKETS
END

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/17101

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :HO4N 7/10, 7/14
US CL :Please See Extra Sheet.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 345/327; 455/3.2, 4.2, 5.1,427, 12.1; 395/200.65, 200.8, 200.33, 200.47, 934; 348/7, 10, 12, 13

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS - satellite, internet, web,

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,579,308 A (HUMPLEMAN) 26 November 1996 (26.11.96), col. 2, lines 3-40, col. 3, line 15 - col. 4, line 22, col. 5, lines 6-49, col. 7, lines 1-22, fig. 8.	1-10
X, P	US 5,778,181 A (HIDARY et al.) 07 July 1998 (07.07.98), col. 1, line 61 - col. 4, line 33, col. 5 line 16 - col. 6, line 24, fig. 1.	1-10
X, P	US 5,675,390 A (SCHINDLER et al.) 07 October 1997 (07.10.97), col. 3, lines 33-67, col. 7 line 44 - col. 8 lines 29, col. 14, lines 1-14, fig.1, fig. 10.	1-10
A, E	US 5,819,049 A (RIETMANN) 06 October 1998 (06.10.98).	1-10

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 OCTOBER 1998	01 FEB 1999

Name and mailing address of the ISA/US	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/17101

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A, P	US 5,793,973 A (BIRDWELL et al.) 11 August 1998 (11.08.98).	1-10
A, E	US 5,818,441 A (THROCKMORTON et al) 06 October 1998 (06.10.98).	1-10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/17101

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

345/327; 455/3.2, 4.2, 5.1,427, 12.1; 395/200.65, 200.8, 200.33, 200.47, 934; 348/7, 10, 12, 13